VOLCANOLOGICAL AND TECTONO-MAGMATIC EVOLUTION OF THE CADIA – FOREST REEFS REGION, SOUTHERN MOLONG VOLCANIC BELT, AUSTRALIA

by

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STATEMENT

This thesis contains the result of research done in the School of Earth Sciences, University of Tasmania between 1998-2001. This thesis contains no material which has been accepted for the award or any other degree of diploma in any tertiary institution and, to the best of the author's knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

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ABSTRACT

The Ordovician to early Early Silurian volcanic successions of the Cadia – Forest Reefs region in the southern Molong volcanic belt, NSW, comprise the products of at least two intrabasinal volcanic centres and one or more extrabasinal or basin margin centres. The Forest Reefs Volcanics include volcaniclastic apron deposits that onlapped and partially buried the underlying feldspathic turbidites of the Coombing and Weemalla Formations. Pillow lavas of the Mt Pleasant Basalt Member are included in the Forest Reefs Volcanics, and represent the first manifestation of shoshonitic volcanism in the Cadia – Forest Reefs region, associated with the development of a broad volcano. Shoshonitic magmatism was interrupted by regional uplift during the late Eastonian (~449-447 Ma), resulting in extensive limestone formation and the synchronous/subsequent emplacement of widespread, but small volume adakitic intrusions (Copper Hill-type Dacite). Regional subsidence in the Bolindian led to deposition of the coarse volcaniclastic apron deposits of the upper FRV, which unconformably overlie the lower FRV. Voluminous shoshonitic magmatism in the early Llandovery (about 440-437 Ma) resulted in the broadly synchronous emplacement of the evolved shoshonitic lavas and shallow intrusions of the Nullawonga Latite Member, and the high-K calc-alkaline to shoshonitic hypabyssal intrusions. Volcanism in the Cadia – Forest Reefs region was generally non-explosive, and no evidence exists to support the existence of a large, subaerial collapse caldera. Instead, the shallow intrusions and lavas of the Nullawonga Latite Member represent the initial (pre-cone) growth stages of a submarine trachyandesite cone. Magmatic hydrothermal fluids associated with emplacement of the evolved, early Llandovery, equigranular intrusions produced the world-class Cadia porphyry-copper deposits.

The high-K calc-alkaline and shoshonitic volcanic and intrusive rocks in the Cadia – Forest Reefs region have distinctive arc-type geochemistry very similar to the lavas and intrusions forming the Pliocene Tavua Caldera in Viti Levu, Fiji. However, the Pliocene shoshonitic rocks at Tavua Caldera were emplaced following cessation of arc magmatism when the arc moved into an extensional phase. By analogy with the

Pliocene tectonic setting in Fiji, the arc-like signature of the Late Ordovician and early Llandovery magmas of the Cadia – Forest Reefs region may be due to pre-processing of the mantle above a subduction zone prior to extension and fragmentation of arc lithosphere that led to generation of the subduction-modified shoshonite-dominated magmas. The adakitic Copper Hill-type Dacite may be the due to a change in arc polarity, involving subduction of hot back-arc basin crust to the west (present-day co-ordinates) beneath the arc.

The quartz-rich turbidites of the Adaminaby and Bendoc Groups are juxtaposed against the feldspathic successions of the Coombing Formation at the southern margin of the Molong volcanic belt. Differences in structural and metamorphic histories, overlapping biostratigraphic ages (at least Gi1 to Ea3, ~461-448 Ma), abrupt changes in rock-type along strike and the lack of evidence for mixing or interfingering between the quartz-rich and feldspathic successions, all strongly suggest that the contact between them is a fault. Similar structural and metamorphic histories are recorded in the D_3 event of the Adaminaby and Bendoc Groups and the D_1 event of the Coombing Formation. Therefore, the initial juxtaposition of the quartz-rich and feldspathic successions is probably recorded by the high-strain fabrics and upper greenschist facies metamorphic assemblages associated with the D_2 event in the Adaminaby and Bendoc Groups. These structural and metamorphic characteristics are consistent with the juxtaposing structure being a large extensional fault.

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